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Philip J. Darlington, Jr.

"STONING" IN ANTS — A SURPRISING NEWLY-DISCOVERED BEHAVIOR



Drawing by Turid Hölldobler.

The stone throwers (Conomyrma bicolor) attack the honey ants (Myrmecocystus mexicanus).



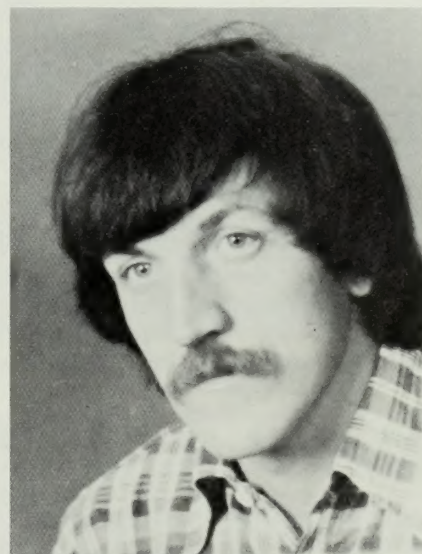
Stone thrower in action.



Honey ants defending the nest.

Photos by Gary Alpert.

The popular image of the industrious ant endlessly scurrying on its virtuous path has been slightly tarnished by the recent discovery of Dr. Michael J. H. Möglich that the repertoire of one species of ants (dubbed "stone throwers") includes throwing stones into the nests of another species, the honey ants. This unexpectedly aggressive behavior, which appears to serve the purpose of preventing the honey ants from foraging to the shared food source, was observed by Dr. Möglich, a postdoctoral fellow from the University of Frankfurt studying various aspects of insect biology at the MCZ, during his first field season in Arizona during the summer of 1976.



Dr. Michael J. H. Möglich.

Intrigued, Dr. Möglich and his collaborator, graduate student Gary Alpert, conducted a thorough study of these ants during the 1977 field season. Close observation yielded more questions than answers. For instance, they found that it was not the mechanical
(continued on next page)

PROFESSOR WILLIAM D. HAMILTON VISITS THE MCZ



On the way from leaving his teaching position at Imperial College, London to assuming a professorial position at the University of Michigan next Fall, Dr. William D. Hamilton spent this Spring semester as Visiting Alexander Agassiz Professor of Biology at the MCZ.

Professor Hamilton is well known for his fundamental work on social behavior; a landmark paper published in 1964 on the evolution of social behavior, with particular reference to altruism, forms the basis for the burgeoning development of this area into the new discipline of sociobiology.

Dr. Hamilton's paper used theoretical population genetics to clarify the way in which evolution acts on the individual in social situations. In the early 60's it was widely believed that adaptations, and particularly adaptive social behavior, benefitted the species rather than the individual. (The most recent emphasis has it that in the final analysis neither the species nor the individual, but the gene is selected for, prompting Richard Dawkins to christen it *The Selfish Gene* in the title of his book). Dr. Hamilton succeeded in bringing social behavior into the realm of evolutionary biology.

Dr. Hamilton's theories provide the framework for interpreting the wealth of data, accumulated in the last ten years, from field studies of animal behavior. Long term studies with individually known animals (James Malcolm's wild dog study is a perfect example) have provided a clearer view of the selective forces acting to shape

social behavior and can possibly provide insights into human behavior.

Although Professor Hamilton gives highest priority to his theoretical work, he has kept in touch with living animals through field studies on social wasps and fig wasps in Brazil and the faunal relationships in rotting wood in England. Professor Hamilton is pleased to be emigrating to the United States because there is much more activity in the field of social behavior on this side of the Atlantic. Aside from teaching in Professor Trivers' course ("Social Theory Based on Natural Selection"), he has been completing several research papers and visiting other American universities this Spring. He looks forward to his new position at the University of Michigan, where a great deal of graduate work is being done in his field.

"STONING" IN ANTS

(continued from front page)

stone throwing action that inhibited the honey ants because, when the researchers simulated this behavior, the honey ants were unaffected. It is possible that the stone throwers add a chemical component to the weapon; however, the current theory is that the mere physical presence of the stone throwers surrounding the nest is sufficient to keep the honey ants in a state of siege.

Another unsolved riddle is how the honey ants survive if the stone throwers are totally successful in preventing them from foraging. Although the honey ants can survive without foraging for long periods since they have an extremely efficient food storage system (one ant's body swells to become a living honey pot from which it feeds the other ants by regurgitation), they must emerge sometime. One possible explanation is that they forage seasonally and that the summer, when Dr. Möglich and Mr. Alpert have made their observations, is the off-season. This year's field work should shed more light on this remarkable behavior.

The strange relationship between the stone throwers and the honey ants is only one aspect of Dr. Möglich's research work, which encompasses behavior, communication, orientation, and division of labor in social insects in general and ants in particular. Dr. Möglich plans to return to Germany this Fall to rejoin his wife, who is also a biologist, and continue his academic career there.

E. O. WILSON AUTHORS TWO NEW BOOKS

Caste and Ecology in the Social Insects and *On Human Nature*, two new books from the prolific pen of Dr. E. O. Wilson, Professor of Biology and Curator of Entomology in the MCZ, will appear in the near future. Dr. Wilson, who, incidentally, will receive two honorary degrees this commencement season (one from Duke University in North Carolina and the other from Grinnell College in Iowa, where he will also deliver the commencement address) collaborated with Professor George F. Oster of the University of California at Berkeley on *Caste and Ecology in the Social Insects*, to be published this summer by Princeton University Press.

Dr. Oster, who is a mathematician and theoretical population biologist, and Dr. Wilson, an entomologist and behaviorist specializing in the social insects, meshed disciplines during a sabbatical year, supported by a grant from the Guggenheim Foundation. The resulting work is the first comprehensive theory of the evolution of caste and the division of labor in social insects using many of the methods of mathematical analysis that have hitherto been employed only in such areas as economics and engineering; here, ant and termite colonies have been treated as economic systems. As Dr. Wilson puts it: "This study is important because caste and the division of labor is at the heart of social organization in insects, as it is in human beings."

The second book, *On Human Nature*, coming out in October from Harvard University Press, follows *The Insect Societies* (1971) and *Sociobiology: The New Synthesis* (1975) and is the result of the author's readings in human behavior and discussions with social scientists over the last three years with the explicit goal of preparing himself to write on human behavior. According to Dr. Wilson, his purpose was to "substantially strengthen, clarify, and expand the ideas that were introduced in the book *Sociobiology*." This new book is a review of existing information combined with a more philosophical consideration of the consequences of applying the research methods of the natural sciences to theories of human social behavior. *On Human Nature* is a non-technical book with an evocative premise; aimed at a general, educated audience, it is bound to be widely read and discussed.

A STUDY OF SOCIAL BEHAVIOR OF WILD DOGS IN AFRICA OR TWO YEARS IN A LAND ROVER

After nearly two years in Tanzania studying the social behavior of wild dogs, graduate student James R. Malcolm returned to Cambridge in January to record his findings in his Ph.D. dissertation. Mr. Malcolm, who came to the MCZ from Oxford University, England, observes that there are several distinct advantages and disadvantages to working with his particular research animal in the field.

Among the advantages:

- 1) Accurate records on the composition of some packs have been kept for up to ten years;
- 2) Since each dog has a distinctive skin pattern, researchers can take their photographs and be assured of positive identification of each individual in future encounters;
- 3) The dogs are entirely tame and come over to the field vehicles willingly (as a matter of fact, they are so tame that they often risk being run over by lying in the grass right in front of the Land Rover); and
- 4) The short grass plains of the Serengeti, where they live, allow the researcher perfect visibility.

However, the situation is not entirely idyllic. Among the drawbacks:

- 1) The area covered by the total population of about 50 or 60 animals is approximately 2,200 square miles. This relative scarcity makes finding them in the first place somewhat of a challenge;
- 2) Wild dogs are not territorial and constantly rove around in packs. Each dog has a range of at least 600 miles. The only time the pack remains in one place is for a three-month period while the pups are born.

To overcome these obstacles, Mr. Malcolm took to the air to find the dogs and then attached radio collars to keep track of them by telemetry.

Through the close observation of these wild dog groups, a great deal is now known about their social behavior. For instance, there is a high degree of sex role reversal. In wild dogs it is the female which initiates courtship, moving from pack to pack and competing with other females for dominance and breeding opportunities. The males stay with the pack where they were born and play the major role in raising pups. Adult males outnumber adult females by a ratio of two to one. This is partly attributable to a biased sex-ratio at birth. Mr. Malcolm is attempting to ar-

rive at an interpretation for this skew in the birth rate, which is not related to physical size, since males and females weigh the same at birth. The subsequent marked divergence in male-female behavior further contributes to the disparity in the sex-ratio. Competition between adult females to reproduce almost certainly leads to higher female mortality. Although fights to the death between females have not been observed, females have been seen to mysteriously disappear from packs and almost certainly could not have survived alone. In one case six sisters arrived together and joined a pack. After two years, only one stayed and she remained the breeding female for another four years.

Meanwhile the males provide the most food for the pups by killing a wide range of prey animals, but mainly gnus and gazelles, bringing back the food, and feeding the pups by regurgitation. This well-documented study should be able to give precise data on the generosity of different adults in the pack to the pups. As the genetic relationships between adults and pups are known, it is



James R. Malcolm.

possible to see if close relatives give more food than distant relatives as William D. Hamilton's kinship theory would predict. Preliminary analysis suggests that there is no simple correlation between degree of genetic relatedness and generosity and other factors, such as age and sex, must be taken into account.

Mr. Malcolm's study also covers other aspects of wild dog behavior including how members of the pack communicate; he is particularly interested in the greeting behavior that occurs before a pack hunts.

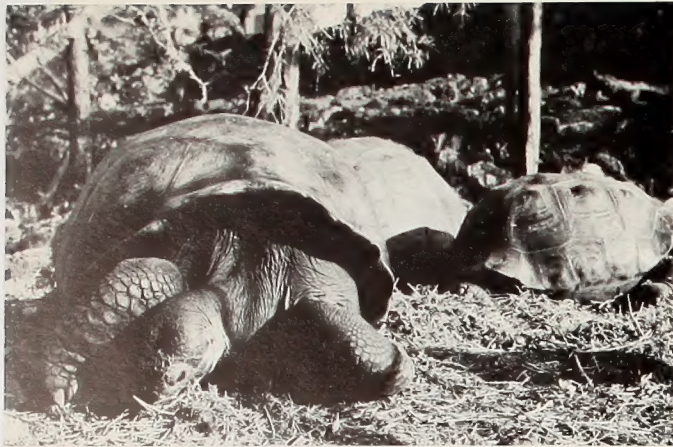


Wild dogs with gazelle prey. Note the distinctive skin patterns which allow for reliable individual identification.



Wild dog pups fight over food.

Photos by James Malcolm.



GALAPAGOS

Photo by Paula Chandoha.

Giant tortoises at the Charles Darwin Research Station, Academy Bay.



Photo by Emily Scott.

Michael McCaskey of the Harvard Business School being checked out by a sea lion pup and watchful mother on this year's trip.



HAWAII

Photo by Julia Yoshida.

On the Hawaiian trip we'll see the nene goose, the endemic "state bird". . .



Photo by Phillip Lobel.

and many butterfly fishes.

TWO NEW TRIPS ADDED TO FRIENDS TRIP PROGRAM FOR 1979

The Friends of the MCZ Trip Program is growing. Plans for 1979 include repeats of three popular trips — Baja whale watching (January 28-February 4); Ecuador, which includes five days on a floating hotel on the Rio Napo, one of the headwaters of the Amazon (March 17-28); and an extended version of the trip to the Galapagos Islands, including Tower Island, for the first time (March 28-April 10). The two new trips are Hawaii (February

17-March 5) and Peru (March 28-April 8).

Snorkellers, whale enthusiasts, and birders should all enjoy the Hawaii trip which includes three days of snorkelling off Kona, one of the finest coral reef areas in the world, accompanied by MCZ graduate student Phillip Lobel, a coral reef fish expert; four days of humpback whale watching on a chartered boat off Maui; and

birdwalks in the volcano area on the islands of Hawaii and Kauai.

The Peru itinerary will please both birders and ruins fanciers. We will be visiting the famous Guano Islands off Paracas to see a multitude of sea birds and also the Peurto Maldonado region, home of more than 170 species of birds. We will spend two nights at the only hotel at Machu Picchu and also visit the ancient city of Cuzco.

Complete itineraries and reservation cards for all next year's trips are now available from the Friends' office (617-495-2463).

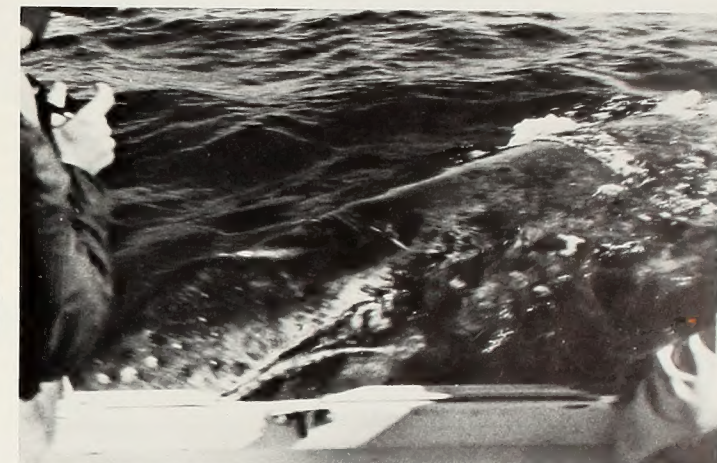


Photo by Andrea Hedin.

BAJA

You can't get much closer. A baby gray whale nuzzled right up to one of the small skiffs on last March's Baja whale watching trip. It was patted by all aboard.

PERU

Two of Peru's treasures: the ruins at Machu Picchu and an alpaca.

Photo by Frank Gardner.



We might see a tapir at Peurto Maldonado.

Photo by Kenneth I. Miyata.



ECUADOR

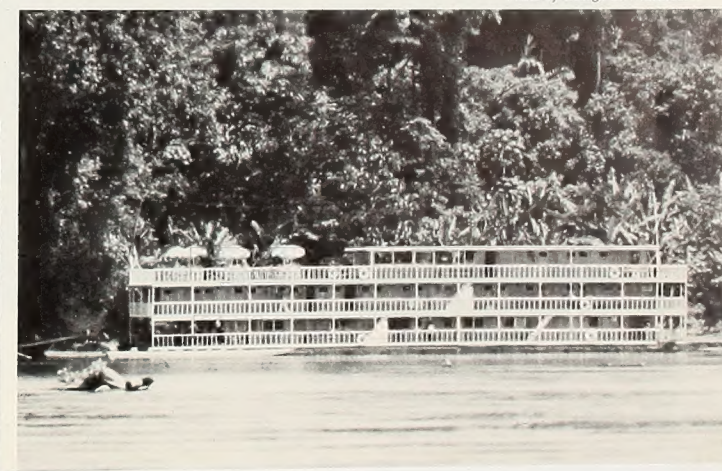
Saturday is market day for the Otovalo Indians, weavers of exquisite ponchos and blankets — a highlight of the Ecuador trip.

Photo by George G. Whitehouse.

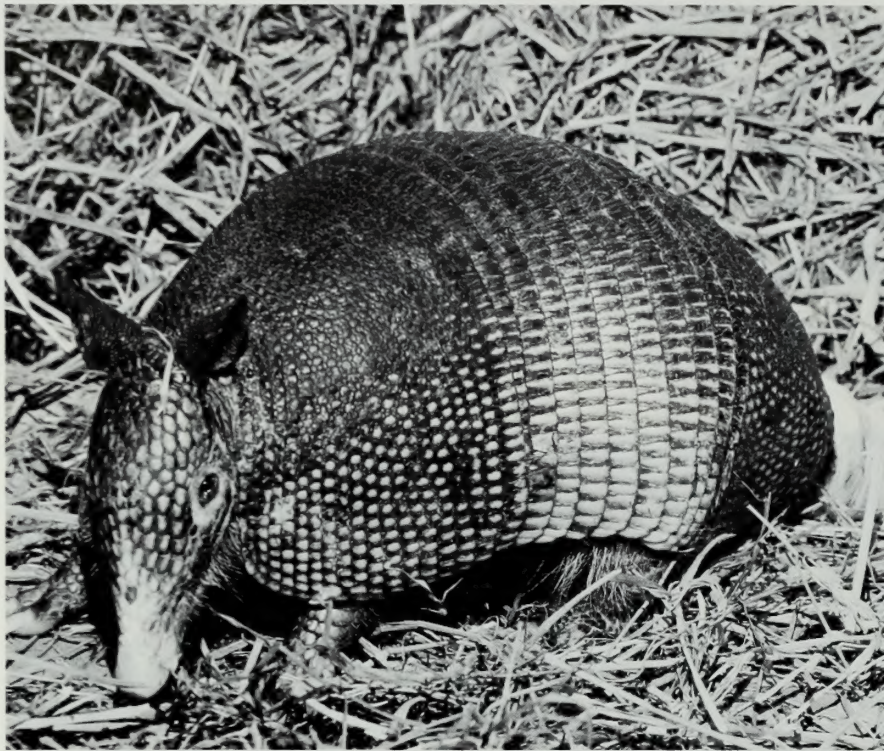


The Flotel Orellana, our floating home on the Ecuadorian Amazon, with dugout canoe (left), our transport on daily river excursions.

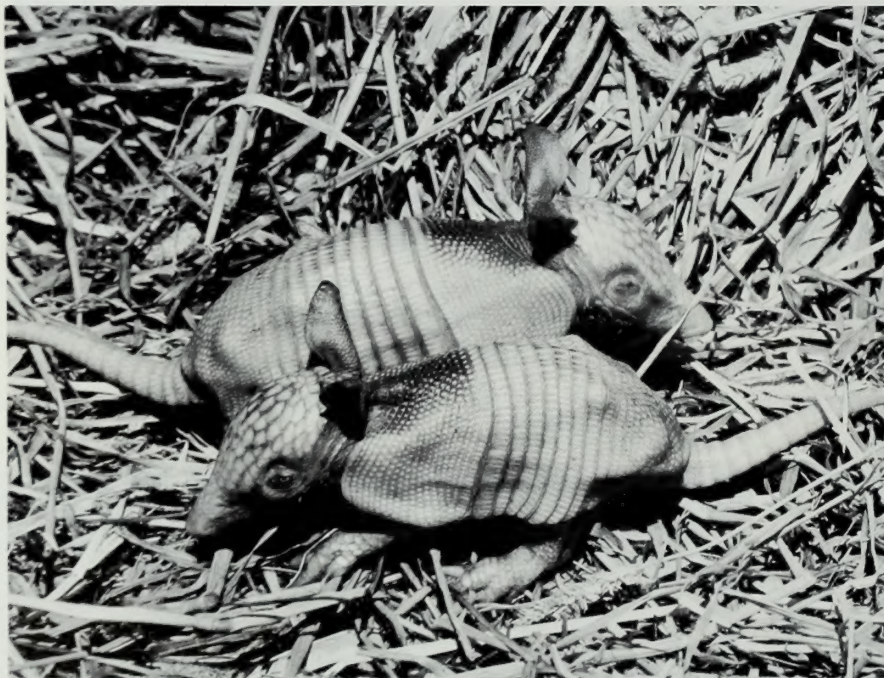
Photo by George G. Whitehouse.



EXOTIC ANIMALS ARE A COMMON SIGHT IN THE MCZ LABS



Adult armadillo



...and five day old offspring. These armadillo babies were born at the MCZ recently. Graduate student Kent Redford is conducting a thorough study of their ecology and behavior in the field (he leaves for their native Paraguay this Fall) as well as looking closely at how they masticate in the lab. There are 22 species of armadillos ranging in size from six inches to five feet and since the fossil record is sparse and very little data has been gathered on them so far, Mr. Redford appears to have a challenging task ahead of him.

The second floor of the MCZ Labs is a zoo, literally. Here a lively research group is conducting studies on a variety of animals to more fully understand their evolution, structure, and function. The lab work, which includes surgically implanting markers and then plotting bone and muscle function with the aid of cineradiography, is combined with observation in several far-flung field localities.



This monitor lizard from Africa is not being rude. Its long tongue, which is a sensing device, is informing him of graduate student Kathleen Smith's obviously friendly intentions. How the extremely mobile skull works in these reptiles is part of Ms. Smith's doctoral research.



A cineradiograph of a monitor's skull allows detailed study of the moving parts.



Deedra McClearn with her research animal — a coati from South America. Ms. McClearn is studying locomotion in this arboreal member of the racoon family. Close observation of the frequency pattern of locomotion in the field is being compared with lab data.



Martha L. Hyde is studying the locomotion of these extremely active kangaroo rats from the deserts of the United States Southwest. Her research recently suffered a slight setback due to an outbreak of armadillo predation in the animal room.



Lisa Moeller, Senior Research Assistant, with one of her charges. This deodorized skunk is being studied by Visiting Lecturer Ted Goslow.

A coati where it is often found in the wild — up a tree.

Photo by Deedra McClearn

VERTEBRATE PALEONTOLOGY COLLECTION GRANT AWARDED

In two years the MCZ's vertebrate paleontology collections will be completely rehoused in new steel cabinets with the aid of a new assistant, thanks to a grant from the National Science Foundation Biological Research Resources Program. Curator Farish A. Jenkins, Jr. and Curatorial Associate Charles R. Schaff welcome this opportunity to complete the renovation project which began five years ago with the reorganization of the entire collection, including fossil mammals, reptiles, and amphibians, and fish.

Although the MCZ's vertebrate paleontology collection is only the tenth largest in the country, it includes many foreign and domestic specimens that are unique. For example, the Triassic faunal collection from Argentina is matched only by that in Tucuman (Argentina). Consequently, the collection is used extensively by other institutions and investigators.

With this grant, the Vertebrate Paleontology Department joins the ranks of the MCZ's Fish, Herpetology, and Entomology Departments, all of which have been entirely renovated since 1972, with the help of generous grants from the National Science Foundation.



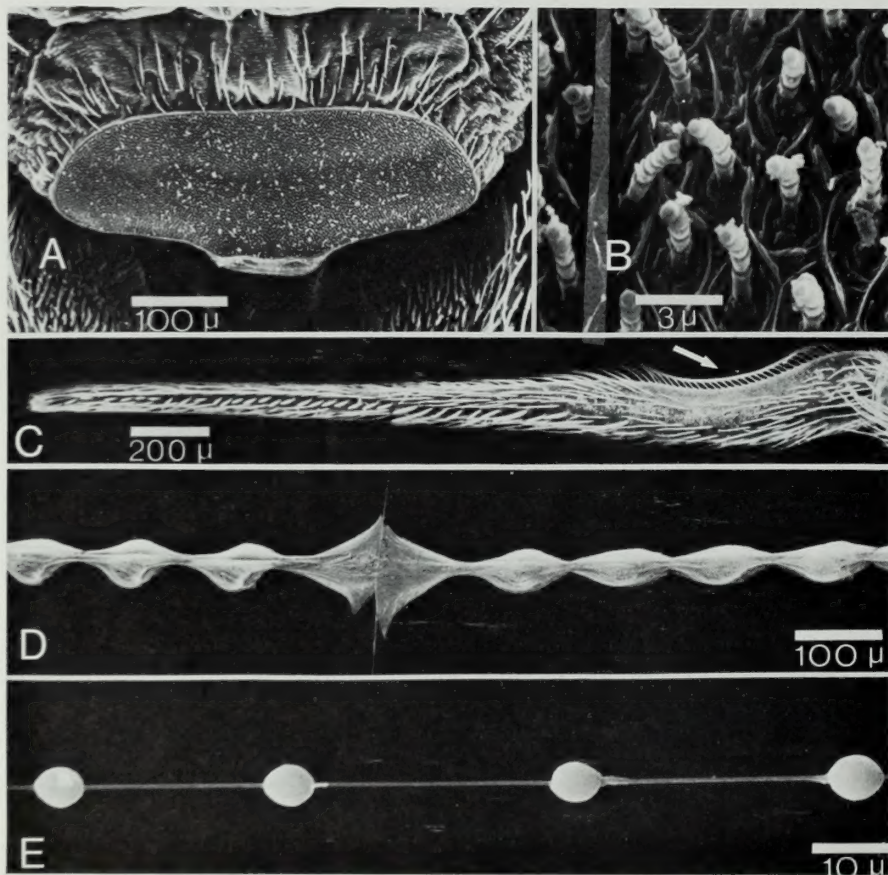
SPIDER SPECIALIST TO TEACH AT VPI

Brent D. Opell, who is completing his Ph.D. research work on spiders at the MCZ, looks forward to a varied teaching schedule (including introductory biology, evolution, and systematics) when he joins the faculty of the Biology Department of Virginia Polytechnic Institute in the Fall.

Mr. Opell is studying the phylogenetic relationships of 16 uloborid genera and revising the species of the Central and South American members of this family. Of the approximately 50 families of spiders, only 15 are orbweavers and only the Uloboridae use cribellate silk, produced by the cribellum, a specialized organ on the abdomen, to capture their prey.



Brent D. Opell



These photos, taken with the scanning electron microscope, show the cribellum (A), a plate on the underside of the spider's abdomen directly in front of the spinnerets, which bears numerous small spinning spigots (B—here enlarged 4,450 times). Each of these spigots produce a fine strand of silk to form a composite sheet which is then combed by a structure on the hind leg, (C—indicated by the arrow). When combined with supporting strands, this fuzzy silk (D) captures the prey insect by entangling its hairs. In contrast, the silk of other orbweavers (E) has evenly-spaced sticky droplets to which insects adhere.

CAN YOU NAME THIS STRUCTURE?



This photograph is part of "Hidden Realities: Microphotographs by Edward Seling", the first exhibition in the MCZ's new changing exhibit gallery. The show includes photographs of this mosquito antenna (inserted in a base and enlarged 52 times), moth eggs, shipworms, and other organisms not usually displayed for the appreciation of their aesthetic qualities. However, these enlargements offer the viewer a glimpse into a microscopic world of unsuspected beauty.

SUMMER DRAWING COURSE

Karen Stoutsenberger Velmure will teach *Drawing from Nature with an Introduction to Scientific Illustration* on Monday, Wednesday and Friday mornings from July 10 to August 4, 1978. Tuition: Friends of the MCZ — \$60.00; others — \$70.00 For more information, call 617-495-2463.

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